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DREDGED MATERIAL RESEARCH. NOTES, NEWS, REVIEWS ETC. VOLUME D-7--ETC(U)
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INFORMATION EXCHANGE BULLETIN

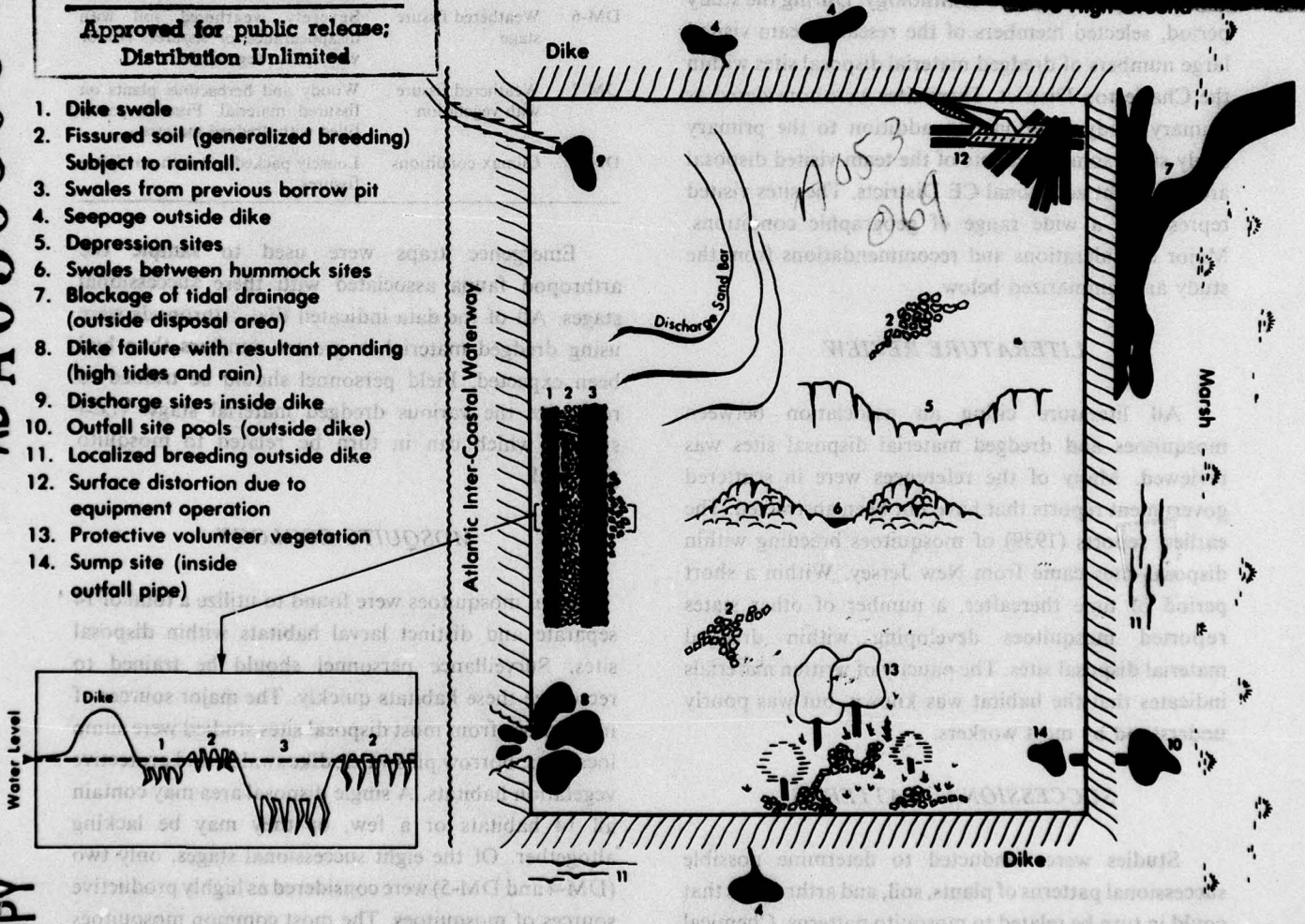
Vol D-78-6
Jun 1978

DREDGED MATERIAL RESEARCH

NOTES · NEWS · REVIEWS etc

Volume D-78-6.

1. Dike swale
2. Fissured soil (generalized breeding) Subject to rainfall.
3. Swales from previous borrow pit
4. Seepage outside dike
5. Depression sites
6. Swales between hummock sites
7. Blockage of tidal drainage (outside disposal area)
8. Dike failure with resultant ponding (high tides and rain)
9. Discharge sites inside dike
10. Outfall site pools (outside dike)
11. Localized breeding outside dike
12. Surface distortion due to equipment operation
13. Protective volunteer vegetation
14. Sump site (inside outfall pipe)



Mosquito control is a problem in confined dredged material disposal area operation and management in many geographical locations. As a part of the Dredged Material Research Program (DMRP) Task 2C: Containment Area Operations, a series of studies were conducted by an interdisciplinary team to analyze the conditions that affect the production of mosquitoes within disposal sites and to recommend control measures. The team identified 14 habitats (above) that were utilized by larval mosquitoes within disposal sites and recommended that surveillance personnel should be trained to recognize and inspect these potential mosquito-breeding habitats. The study and other recommendations of the team are described in the following article.

MOSQUITO CONTROL

A series of studies were conducted by an interdisciplinary research group at The Citadel, the Military College of South Carolina, to analyze the conditions (biological, chemical, physical, and political) that affect the production of mosquitoes within dredged material disposal sites and to recommend control measures. The studies were conducted under the direction of Dr. Wm. Bruce Ezell, Jr., as part of Task 2C "Containment Area Operations" of the Disposal Operations Project (DOP). The following disciplines were represented on the research team: general entomology, medical entomology, political science, general ecology, biological control, biometry, civil engineering, botany, and ornithology. During the study period, selected members of the research team visited large numbers of dredged material disposal sites within the Charleston District. These sites were considered as primary study locations. In addition to the primary study sites, some members of the team visited disposal areas in eight additional CE Districts. The sites visited represented a wide range of geographic conditions. Major considerations and recommendations from the study are summarized below.

LITERATURE REVIEW

All literature citing an association between mosquitoes and dredged material disposal sites was reviewed. Many of the references were in scattered government reports that have not been abstracted. The earliest reports (1939) of mosquitoes breeding within disposal sites came from New Jersey. Within a short period of time thereafter, a number of other states reported mosquitoes developing within dredged material disposal sites. The paucity of written materials indicates that the habitat was known, but was poorly understood by most workers.

SUCCESSIONAL PATTERNS

Studies were conducted to determine possible successional patterns of plants, soil, and arthropods that could in turn be related to mosquito patterns. Chemical characterizations of soil samples from several disposal sites with a history of producing mosquitoes were conducted. From these and other tests, a classification of soil weathering stages was proposed. Eight different successional stages (Table 1) based on soil patterns were identified and studied.

Table 1
SUCCESSIONAL STAGES OF DREDGED MATERIAL DISPOSAL AREA

Stage	Designation	Appearance
DM-1	Supernatant liquid stage	Clear to cloudy supernatant water over the surface.
DM-2	Bare mud stage	Wide expanses of mud (no fissures).
DM-3	Incipient fissure formation stage	Long, tenuous, shallow cracks in the dredged material surface.
DM-4	Mature fissure stage	Deep fissures. Mosaic blocks distinctly formed.
DM-5	Vegetated mature fissure stage	Integrity of initial fissure formation is maintained although vegetation is present.
DM-6	Weathered fissure stage	Severely weathered soil with disappearance of fissures. No or very sparse vegetation.
DM-7	Weathered fissure with vegetation	Woody and herbacious plants on fissured material. Fissures partly filled with dredged material.
DM-8	Climax conditions	Loosely packed soil with no visible fissures.

Emergence traps were used to sample the arthropod fauna associated with these successional stages. All of the data indicated that arthropods were using dredged material in greater numbers than had been expected. Field personnel should be trained to recognize the various dredged material stages (DM stages), which can in turn be related to mosquito potential.

MOSQUITO ECOLOGY

Larval mosquitoes were found to utilize a total of 14 separate and distinct larval habitats within disposal sites. Surveillance personnel should be trained to recognize these habitats quickly. The major sources of mosquitoes from most disposal sites studied were sump locations, borrow pit swales, dike swales, and protective vegetation habitats. A single disposal area may contain all 14 habitats or a few, or they may be lacking altogether. Of the eight successional stages, only two (DM-4 and DM-5) were considered as highly productive sources of mosquitoes. The most common mosquitoes found in the East and Gulf Coast disposal sites were the *Aedes sollicitans* and *Aedes taeniorhynchus*. Mosquito fauna increased in species diversity with increasing age of a disposal site.

Adult mosquitoes were collected using modified New Jersey light traps powered by automobile batteries. A total of 3562 specimens representing six species were processed from the light trap catches. Only one species, *Uranotaenia sapphirina*, was collected by light trap that had not been previously collected in the larval stage. Light trap catches were compared with weather data during the period of operation using a cross-covariance analysis technique.

SITE VISITATIONS

For the eight CE Districts visited, in general, the mosquito fauna associated with dredged material disposal sites did not appear to vary greatly. The exceptions were the different West Coast species and the fact that *Aedes taeniorhynchus* was not noted as a major pest species in the Philadelphia CE District. With some exceptions the proposed DM stages appeared to be valid in all Districts contacted. All of the 14 larval mosquito habitats located in the primary study areas were also readily observed during the CE District site visitations. As a result of the site visitations, confidence was gained as to the validity of the models proposed from the primary study areas.

CONTROL STUDIES

Control studies were considered under three categories: biological, chemical, and physical. No biological control measures appear practical at this time for dredged material disposal sites. A survey of current and future possibilities was made, however. Several feasibility studies were made using new insect growth regulator (IGR) compounds. If proven environmentally safe, these materials may hold promise as chemical control tools. More extensive tests were conducted using physical control measures. The Riverine Utility Craft (RUC) was found to be useful in the dewatering of disposal areas. Soil amendments were found to be capable of reducing the formation of soil fissures (and therefore mosquito habitats) under test plot conditions. Preliminary testing of rim-ditching to drain surface water as a control measure was accomplished with limited success.

BOTANICAL STUDIES

This portion of the study revealed a number of plant species that were associated with mosquito larval habitats. In general, those plants (mainly halophytes) that were capable of growing on fissured dredged material were associated with larval mosquitoes. Further research is needed to determine if specific plants are specifically attractive to various species of mosquitoes. A pattern of succession of plant communities was proposed and documented. Estimates of standing crop values of some plant species in pure stands in disposal sites were made and found to be higher than expected, indicating that dredged material could support some marsh plants luxuriously. A listing of plant species collected or encountered during the study was done by habitat preference, CE District, and as a pooled composite from all locations.

AVIAN STUDIES

Bird species are the major vertebrate fauna associated with most dredged material disposal sites. They are related to mosquito populations in two ways: they constitute a source of blood for mosquitoes and thereby may sustain a large breeding population of mosquitoes, and birds may function as reservoir host for a group of pathogenic arboviruses. For these reasons a study of the avifauna of disposal sites was included as a major part of mosquito ecology. Birds were found to utilize disposal sites in many ways, and a complete listing of all birds known to be associated with the primary study sites of this report was compiled. Estimates were also made on the numbers and kinds of birds using disposal sites as rookeries.

CONCLUSIONS

A number of unusual conditions were documented that must be considered before plans for a mosquito pest management plan can be implemented. All dredged material disposal sites vary from one another, primarily in age and successional stages of the dredged material. Proper and timely surveillance are the initial steps to mosquito abatement within disposal sites. Personnel must be trained to recognize the presence (or absence) of the 14 larval mosquito habitats that can develop within disposal areas. Inspectors also need the ability to recognize the various DM stages and plant successional stages. Aerial surveillance can be both useful and accurate if personnel are trained to observe closely the ecological markers mentioned in this report.

Mosquitoes can be controlled by a variety of conventional and unconventional methods in disposal sites. Inasmuch as all chemical control is temporary, some cautions should be considered before any organic chemical is used for a sustained period of time as a mosquito-control agent. It is a known fact that sustained sublethal contact with certain organic poisons by mosquito larvae will induce genetic resistance to the poison. Nontarget organisms (i.e., marsh invertebrates) may also be harmed by the indiscriminate use of poisonous materials. When the above reservations have been considered and the use of chemicals is recommended, a number of chemical pesticides are available and effective. Inasmuch as the allowable use of many chemicals is subject to change, local recommendations must be consulted; therefore, no listing of pesticides was included in the report of this study.

Many of the above problems (e.g., genetic resistance) are not encountered when physical control measures are employed against mosquitoes. These measures require longer periods of time for implementation, but the effectiveness is unquestionable. Three physical control measures were considered: use of the RUC and rim-ditching to drain surface water and addition of soil amendments to prevent fissures. In general, almost any physical control measure that will allow for drainage and/or flushing actions by tides will eliminate mosquito larvae. The investigators strongly recommended that additional research is needed on biological and physical control measures within dredged material disposal sites.

In many cases a complex of government agencies was observed to affect environmental policy planning regarding mosquito control within disposal sites. In such an atmospher, interagency cooperation becomes a necessity if rational measures are to be employed in mosquito abatement (this was especially documented by the attitude and opinion survey).

Mosquitoes can be controlled within dredged material disposal sites if proper consideration is given to the following items:

- The peculiar ecology of disposal areas must be understood as distinct from surrounding marsh or other environments.
- A pattern of regular mosquito inspection and surveillance procedures must be established by the agency performing control services. These activities must also be related to rainfall patterns. Generally, removal of water (rainfall, tides, etc.) from a disposal site (including from fissures) within 7 to 10 days will prevent the production of adult mosquitoes.
- Personnel must be trained for both aerial and ground inspection procedures including the recognition of the 14 larval habitats cited in this report, the importance of the various DM stages, plant successional patterns, and the importance of bird-mosquito relationships.
- A regular program of information exchange between CE Districts and mosquito abatement programs must be established. Every effort should be made to inform local mosquito abatement programs of disposal area management decisions. Procedures for local mosquito abatement program input into disposal site management should be developed.
- In order to achieve an integrated control program for mosquito pest management in disposal sites, proper consideration to the roles of biological, chemical, and physical measures must be given. The ideal program should employ each option to the best, environmentally safe advantage.

More detailed guidance on mosquito control will be published in the final report on this work unit. This work unit was managed by Dr. Luther F. Holloway. Managers of Task 2C during the conduct of the study were Mr. Newton C. Baker and Ms. Marian E. Poindexter. Mr. Charles C. Calhoun, Jr., was the DOP Manager.

RUC'S DELIVERED TO MOBILE AND CHARLESTON DISTRICTS

RUC's were recently delivered to the Charleston and Mobile Districts (Figs. 1 and 2) and training courses

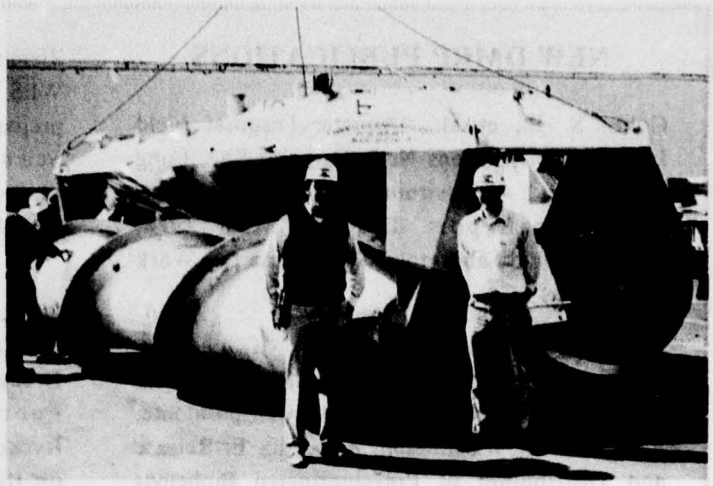


Figure 1. RUC being unloaded at the Charleston District was delivered to (left to right) Larry Snyder, Chief, Maintenance Branch, and Braxton Kyzer, Chief, Survey and Navigation Branch

Figure 2. Upper Pole Cat Bay Disposal Area, Mobile, Alabama, was the scene of a trial run for the RUC delivered to the Mobile District. Participating in the demonstration were (left to right) Carl May, WES; Charles Calhoun, DOP Manager; LTC D. R. Pope, Deputy District Engineer; Forrest Pruett, Chief, Projects Operations Branch; and Paul Warren, Mobile Area Engineer.

were conducted for District operators. The RUC's were obtained by the Disposal Operations Project (DOP) from the Marine Corps and were rebuilt at the Waterways Experiment Station(WES) by personnel at the Mobility Systems Division (MSD) of the Geotechnical Laboratory to better suit conditions in the Districts. The RUC's were obtained by the Districts largely through the efforts of Mr. Pat Langan, Chief, Navigation Section, Mobile District; Mr. Braxton Kyzer, Chief, Survey and Navigation Branch, Charleston District; and Mr. Jim Bradley, Assistant Chief, Construction Operations Division, South Atlantic Division.

The RUC's will be used primarily for the Districts' aggressive disposal-area management plans already under way and the implementation of technology developed under the DMRP Task 5A: Dredged Material Densification. In addition, since the RUC's are multipurpose vehicles, they will also be used for such functions as mosquito control and surveys.

Rebuilding of the RUC's was under the direction of Messrs. E. S. Rush, C. E. Green, W. E. Willoughby, and C. R. May of the MSD. Mr. May also conducted the operators' training courses. Dr. T. A. Haliburton was manager of Task 5A and the manager of DOP was Mr. C. C. Calhoun, Jr.

NEW DMRP PUBLICATIONS

Cobb, S. P., et al., "Aquatic Disposal Field Investigations, Eatons Neck Disposal Site, Long Island Sound; An Environmental Inventory," WES Technical Report D-77-6, May 1978, Environmental Laboratory. (Final Report on Work Unit 1A06.)

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Pavlou, S. P., et al., "Aquatic Disposal Field Investigations, Duwamish Waterway Disposal Site, Puget Sound, Washington; Appendix E: Release and Distribution of Polychlorinated Biphenyls Induced by Open-Water Dredge Disposal Activities," WES Technical Report D-77-24, January 1978, prepared by the Department of Oceanography, University of Washington, for the Environmental Laboratory. (Final Report on Work Unit 1A10D.)

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Richardson, M. D., et al., "Aquatic Disposal Field Investigations, Columbia River Disposal Site, Oregon; Appendix C: The Effects of Dredged Material Disposal on Benthic Assemblages," WES Technical Report D-77-30, December 1977, prepared by the School of Oceanography, Oregon State University, for the Environmental Laboratory. (Final Report on Work Unit 1A07C.)

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Nathans, M. W., and Bechtel, T. J., "Availability of Sediment-Adsorbed Selected Pesticides to Benthos with Particular Emphasis on Deposit-Feeding Infauna," WES Technical Report D-77-34, November 1977, prepared by the LFE Corporation Environmental Analysis Laboratories for the Environmental Laboratory. (Final Report on Work Unit 1D07.)

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Pequegnat, W. E., in collaboration with David D. Smith et al., "An Assessment of the Potential Impact of Dredged Material Disposal in the Open Ocean," WES Technical Report D-78-2, January 1978, prepared by TerEco Corporation for the Environmental Laboratory. (Final Report on Work Unit 1A11.)

Zieman, J. C., et al., "Seagrass Literature Survey," WES Technical Report D-78-4, January 1978, prepared by the Department of Environmental Sciences, University of Virginia, for the Environmental Laboratory. (Final Report on Work Unit 4E01.)

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Long, B. W., and Grana, D. J., "Feasibility Study of Vacuum Filtration Systems for Dewatering Dredged Material," WES Technical Report D-78-5, February 1978, prepared by Ryckman/Edgerley/Tomlinson & Associates, Inc., for the Environmental Laboratory. (Final Report on Work Unit 5C07.)

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Lee, C. R., et al., "Prediction of Heavy Metal Uptake by Marsh Plants Based on Chemical Extraction of Heavy Metals from Dredged Material," WES Technical Report D-78-6, Environmental Laboratory. (Final Report on Work Unit 4A15A.)

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Bokuniewicz, H. J., et al., "Field Study of the Mechanics of the Placement of Dredged Material at Open-Water Disposal Sites; Volume I: Main Text and Appendices A-I and Volume II: Appendices J-O," WES Technical Report D-78-7, April 1978, prepared by the Department of Geology and Geophysics, Yale University, for the Environmental Laboratory. (Final Report on Work Unit 1B09.)

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Palermo, M. J., "An Evaluation of Progressive Trenching as a Technique for Dewatering Fine-Grained Dredged Material," WES Miscellaneous Paper D-77-4, December 1977, Environmental Laboratory. (Final Report on Work Unit 5A08.)

NOTE: Copies of the above reports will be furnished to individual requestors as long as supplies last. Since it is only feasible to print a limited number of copies, requests for single rather than multiple copies by a single office will be appreciated. Please address all requests to the Waterways Experiment Station, ATTN: Ms. D. P. Booth. When supplies are exhausted, copies will be obtainable from the National Technical Information Service, 5205 Port Royal Road, Springfield, VA 22151.

D M~~X~~R P → DOTS

No, this heading does not mean we are changing the name of the Dredged Material Research Program (DMRP)! What it indicates is that as of March of this year, essentially all research under the DMRP was completed on schedule and we are now initiating a related effort known as DOTS. DOTS is the acronym for Dredging Operations Technical Support, an activity of the Environmental Laboratory of the Waterways Experiment Station intended to enhance the application of DMRP technology and research results.

But first a brief status report on the DMRP. Except for the completion of remaining final contract and technical reports, preparation of the series of 21 Synthesis Reports, and completion of the Index and Retrieval System, all in-house and contractor research has been completed. As readers of this bulletin are aware, the number of DMRP reports published per month has escalated noticeably. As of the first of June, 129 reports had been printed and distributed, 52 were in publication, and 33 were scheduled. It is anticipated that the entire set of 214 DMRP reports will be available by the end of September of this year with only the Index and Retrieval System volume to follow shortly thereafter.

Perhaps more than any other single factor, the size and diversity of subject matter of the DMRP "library" prompted the realization that something more would be needed to facilitate the identification and application of DMRP results by Corps operating elements and other agencies. While the Index and Retrieval System would help, a more positive and active effort would be needed to ensure that the full benefits of the research would be realized.

The concept of a small technical support group or advisory team composed of the expertise and experience that had participated in the DMRP was developed and proposed to the Office, Chief of Engineers (OCE). In practice, the team would be available to assist Corps Districts and Divisions in identifying what DMRP information was relevant to a particular problem or issue and how it could be used. As a consequence of the prevailing opinions within OCE that utilization of the best available technology in environmental protection matters is vital to the mission of the Corps and that the investment of $32.8 million in Federal funds must yield tangible dividends, the advisory team concept was approved and funding authorized to begin immediately following the DMRP.

Under this sponsorship, a DOTS team was organized at WES in April and is now functioning as anticipated. To last as long as the need justifies, the team will provide up to 8 man-years of effort in activities such as survey report and Environmental Impact Statement review, permit evaluation, project design assistance, briefings and seminars, plan-of-study formulation, and establishment of project monitoring requirements. Since April, requests for assistance have been received from more than a dozen Corps Districts or Divisions. These are being accommodated at an accelerating rate as the staff committment to completing DMRP reports declines.

During an interim period extending until the end of this fiscal year, DOTS activities are being coordinated and managed by a Program Planning Group consisting of the four DMRP Project Managers (Charles C. Calhoun, Jr., Robert M. Engler, Thomas A. Patin, and Hanley K. Smith) under the direction of the DOTS Program Manager (Roger T. Saucier). Each of these individuals is devoting a significant part of his time to DOTS activities; other WES staff members are participating dependent upon their particular expertise and the nature of the request. The two staff coordinators, Mark D. Malkasian and Kenneth O. Allen (the latter an employee of the U. S. Fish and Wildlife Service), are also participating in DOTS activities.

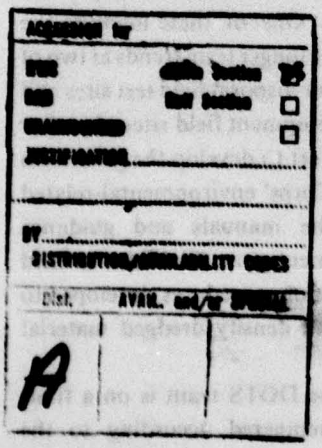
The DOTS management staff will also direct three other DMRP-related activities scheduled to continue through fiscal year 1981. One of these involves the continued monitoring of the longer term trends at two of the four DMRP open-water disposal field test sites and seven DMRP habitat development field sites. Another involves the continuing effort to develop the guidelines and criteria required for Corps' environmental-related permit programs and the manuals and guidance necessary for their implementation. The third is field verification and refinement of procedures developed to size containment areas and densify dredged material within containment areas.

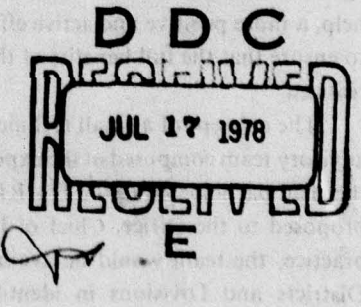
The availability of the DOTS team is on a first-come, first-serve basis, tempered according to the urgency of the situation. Any Corps operating element can request assistance in behalf of its own staff or activities or any matter in which they are acting cooperatively with other agencies or groups. Inquiries should be made to Dr. Saucier (AC 601, 636-3111, Ext. 3233 or FTS 542-3233) or to any member of the DOTS team.

This Information Exchange Bulletin will continue to be published on approximately a monthly basis under the auspices of the DOTS activity as long as there is sufficient information to be disseminated. A backlog of material resulting from the DMRP already is sufficient to ensure issues to the end of this year.

This bulletin is published in accordance with AR 310-2. It has been prepared and distributed as one of the information dissemination functions of the Environmental Laboratory of the Waterways Experiment Station. It is principally intended to be a forum whereby information pertaining to and resulting from the Corps of Engineers' nationwide Dredged Material Research Program (DMRP) could be rapidly and widely disseminated to Corps District and Division offices as well as other Federal agencies, State agencies, universities, research institutes, corporations, and individuals. Although the DMRP was completed in March 1978, all research results have not yet been disseminated to this wide audience. Hence it is being continued until such time as all significant DMRP results and data are summarized. It will be issued on an irregular basis as dictated by the quantity and importance of information available and compiled for publication. Contributions of notes, news, reviews, or any other type of information are solicited from all sources and will be considered for publication as long as they are relevant to the theme of providing definitive information on the environmental impact of dredging and dredged material disposal operations and the development of technically satisfactory, environmentally compatible, and economically feasible dredging and disposal alternatives, including consideration of dredged material as a manageable resource. Special emphasis is placed on materials relating to the application of research results or technology to specific project needs. Communications are welcomed and should be addressed to the Environmental Laboratory, ATTN: R. T. Saucier, U. S. Army Engineer Waterways Experiment Station, P. O. Box 631, Vicksburg, Miss. 39180, or call AC 601, 636-3111, Ext. 3233 (FTS 542-3233).

JOHN L. CANNON
Colonel, Corps of Engineers
Commander and Director





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